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May 7, 2021 File: 021311

Bergeron Construction 2010
287 St-Thomas Road
Vars, Ontario
K0A 3H0

Attention: Ms. Carole Bergeron

RE: SLOPE STABILITY ASSESSMENT
PROPOSED UNDERGROUND PARKING RAMP RETAINING WALLS
12 UNIT APARTMENT BUILDING
5574 ROCKDALE ROAD, VARS
CUMBERLAND WARD, CITY OF OTTAWA, ONTARIO

Dear Madams/Sirs:

This letter report provides the results of a slope stability assessment carried out for the proposed underground parking ramp retaining walls at the above noted proposed 12 unit apartment building site. The purpose of the assessment was to demonstrate that the proposed retaining walls at the site, extending up to a maximum of some 2.1 metres in height, will have a factor of safety against global slope instability/failure of at least 1.5 for static conditions and at least 1.1 for seismic conditions.

The above mentioned proposed retaining walls and the finished grades for the subject site are indicated on the grading plan drawing prepared by and provided to us by email by Blanchard and Letendre Engineering (BLE) and is titled “Site Grading Plan”, for project “12 Unit Apartment Building 5574 Rockdale Road, Vars, On”, drawing No. C200, revision 2 dated 24/08/20. That grading plan drawing should be read in conjunction with this report.

PROPOSED DEVELOPMENT AND SITE BACKGROUND

For discussion purposes Rockdale Road is considered to exist at the east side of the subject site (see Key Plan, Figure 1). The site consists of an irregular shaped parcel of land some 1.8 hectares in plan area located on the west side of Rockdale Road, Vars, in the City of Ottawa, Ontario. It is understood that plans are being prepared to construct a two storey, 12 unit apartment building with underground parking at the site. The above mentioned BLE grading plan drawing indicates proposed retaining walls on either side of the proposed driveway ramp that leads to the underground basement parking area within the proposed building and that the proposed retaining walls are aligned to follow the plan area shape of the driveway ramp. Based on the proposed finished grades and the retaining wall design details shown on the above mentioned BLE grading plan drawing the highest top of retaining walls elevation is indicated to be 79.22 metres and the lowest proposed finished grade elevation at the bottom of the retaining walls is indicated to be 77.18 metres, resulting in a maximum retained height of 2.04 metres. The BLE grading plan drawing further indicates that the proposed finished grades back of the retaining walls is relatively flat and, in general, do not significantly increase in elevation relative to the proposed top of retaining wall elevations.

The proposed retaining walls design details shown on the BLE grading plan drawing indicate that the proposed retaining walls are to consist of manufactured precast concrete blocks.

For the purposes of this report and for a conservative approach, the maximum retained height of the proposed retaining walls is considered to be 2.1 metres.

The results of previous test pits put down by Morey Associates Ltd. at the site in close proximity to the proposed retaining walls indicate that the area of the proposed retaining walls is underlain by a layer of fine to medium sand with a trace to some silt followed by a deposit of silty sand glacial till. A review of several available MOE Water Well Records for wells in the area of the site, obtained from the province of Ontario map-based search website, indicates that between some 3 to 5 metres of overburden followed by shale and limestone bedrock was encountered by the well drillers.

PROPOSED RETAINING WALLS SLOPE STABILITY ANALYSES

Computer stability analyses were carried out for the above mentioned 2.1 metre high retaining walls using GeoStudio 2012 Slope/W software package produced by GEO-SLOPE International Ltd., in order to determine a factor of safety against global failure for the retaining walls. The slope section used in the analyses was chosen by Morey Associates Ltd. to represent the highest retaining wall (as described above). The retaining walls on both sides of the proposed driveway/ramp are indicated to have the same maximum height, therefore one section of retaining wall was analyzed and represents both of the retaining walls.

The soil and bedrock conditions used in the analyses were based on the above described subsurface information and the proposed finished grades/grade raises and structure locations indicated on the above mentioned BLE grading plan drawing. Based on our interpretation of the BLE grading plan drawing no surcharge loads are considered likely adjacent to the top of the highest portions of the proposed retaining walls, however for a conservative approach a live load surcharge (i.e.: vehicle load) back of the top of the retaining walls has been considered in the analyses.

The slope stability analyses parameters used for the retaining wall backfill material are:

Cohesion, c' = 0.5 kilopascals
Internal Friction Angle, ϕ' = 32 degrees
Unit Weight, γ = 22.0 kilonewtons per cubic metre

The slope stability analyses parameters used for the native sand material are:

Cohesion, c' = 0.5 kilopascals
Internal Friction Angle, ϕ' = 30 degrees
Unit Weight, γ = 18.0 kilonewtons per cubic metre

The slope stability analyses parameters used for the native glacial till material are:

Cohesion, c' = 0.5 kilopascals
Internal Friction Angle, ϕ' = 35 degrees
Unit Weight, γ = 20.5 kilonewtons per cubic metre

The slope stability analyses parameters used for the bedrock material are:

Cohesion, c' = 550 kilopascals
Internal Friction Angle, ϕ' = 24 degrees
Unit Weight, γ = 26.0 kilonewtons per cubic metre

The above parameters used in the analyses are based on experience with similar soil types in the Ottawa and surrounding area as well as information published by the Ministry of Natural Resources (MNR) and City of Ottawa relating to the subsurface conditions described above. It is pointed out that the above indicated bedrock parameters represent what is considered a very poor quality rock mass of disintegrated, poorly interlocked, heavily broken rock with a mixture of angular and rounded rock pieces. These bedrock parameters have been selected as a conservative approach. Further, for a conservative approach, the soil was assumed to be nearly fully saturated with the groundwater level within 0.1 to 0.3 metres from the ground surface.

Global stability analyses for the retaining walls were carried out for both static conditions and pseudo-static (seismic) conditions. A seismic coefficient of 0.16 was used in the pseudo-static analysis which is considered half of the peak ground acceleration for the Ottawa area and is the industry norm for pseudo-static stability analysis for the Ottawa and surrounding area.

For the purposes of assessing the results of the computer stability analyses for static conditions, a calculated factor of safety against global failure of 1 or less is considered to indicate the retaining walls to be unstable/failing; a factor of safety against global failure of 1.1 to 1.2 is considered to indicate the retaining walls to be unstable to bordering on failure; a factor of safety against global failure of 1.3 to 1.5 is considered to indicate the retaining walls to be less likely to fail in the long term and provides a degree of confidence against failure ranging from marginal to adequate should actual conditions vary from the assumed conditions and a factor of safety against global failure of greater than 1.5 is considered to indicate long term stability. For pseudo-static conditions a factor of safety against global failure of 1.1 is considered to indicate adequate retaining wall stability.

The results of the slope stability analyses (see Appendix A) indicate that the calculated factors of safety against global failure for the maximum 2.1 metre high retaining walls is 3.2 and 1.7 for static conditions and pseudo-static (seismic) conditions, respectively. The above factors of safety against global failure for static and seismic conditions are above of 1.5 and 1.1, respectively, and are considered to indicate adequate long term stability of the proposed retaining walls.

CONCLUSION

Based on the above calculated factors of safety against global instability/failure, it is considered that the above mentioned proposed maximum 2.1 metre high retaining walls are in no danger of a global instability/failure.

We trust the above information is sufficient for your present purposes. If you have any questions concerning this letter, please do not hesitate to contact our office.

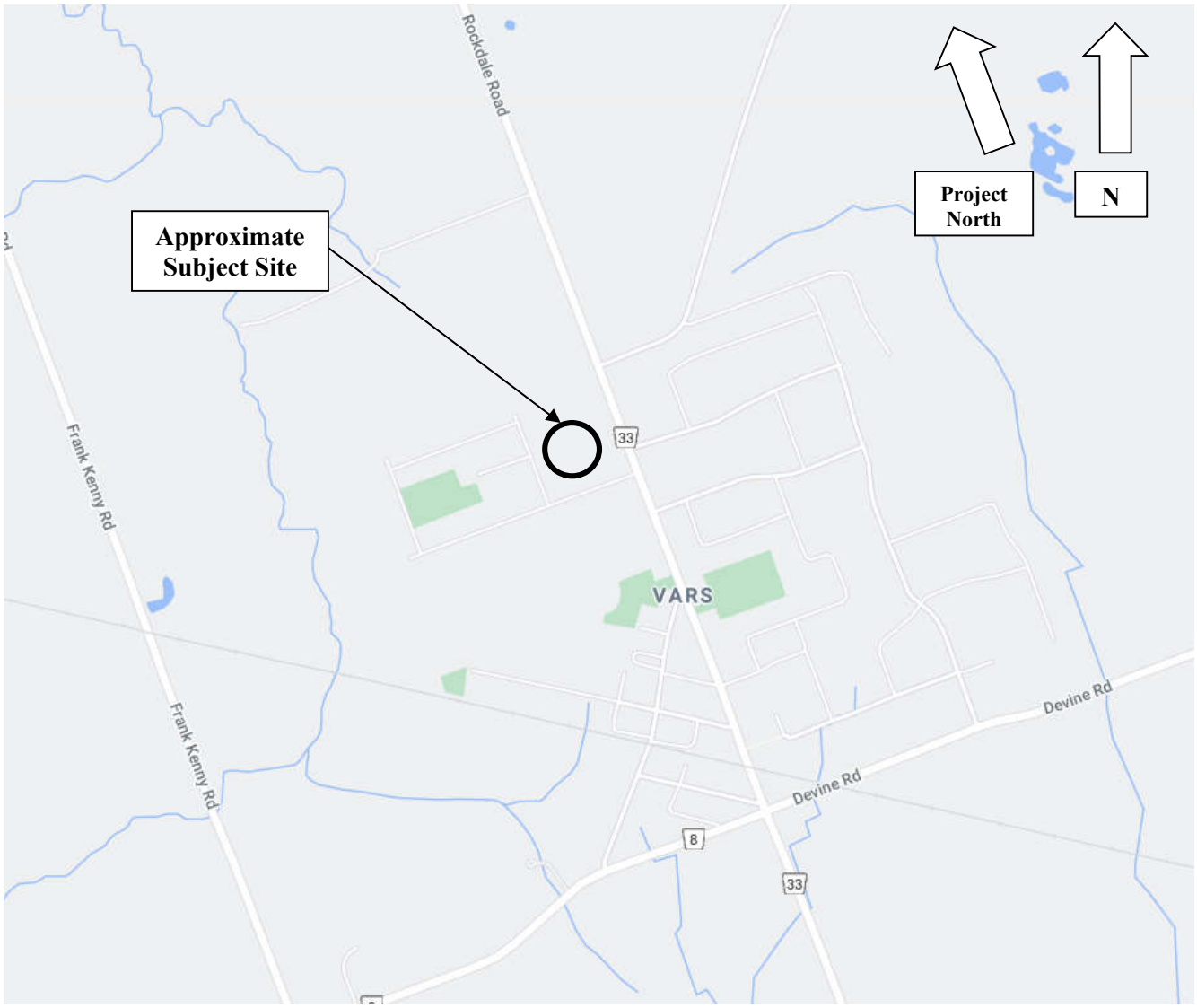
Yours truly,
Morey Associates Ltd.

D. G. Morey, P.Eng.
Director/Civil Engineer

Attachments: Figure 1
Appendix A

File: 021311

KEY PLAN	FIGURE 1



NOT TO SCALE

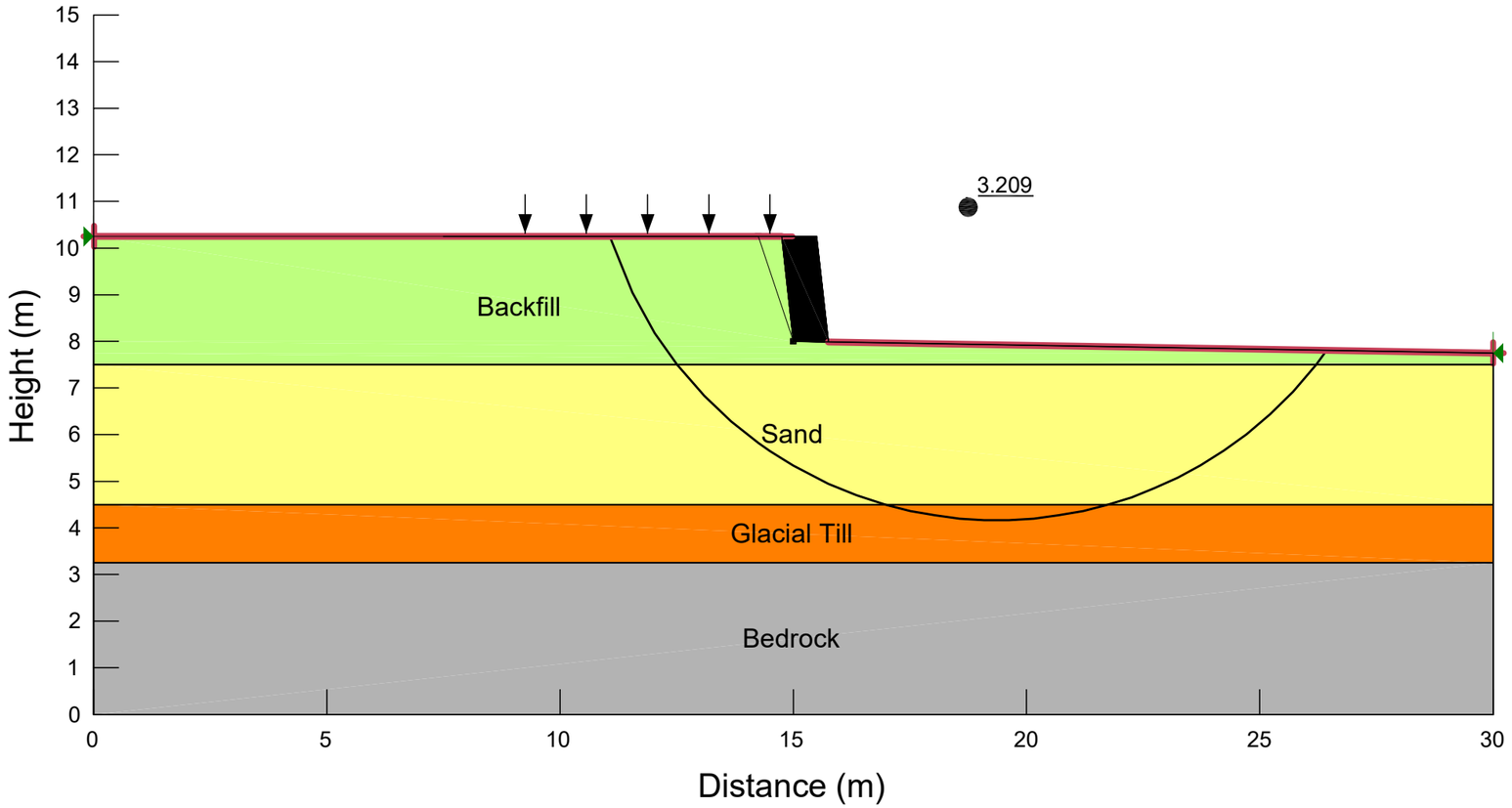
MOREY ASSOCIATES LTD.
CONSULTING ENGINEERS

Project No. 021311

Date May 2021

APPENDIX A

COMPUTER SLOPE STABILITY ANALYSES RESULTS
STATIC AND PSEUDO-STATIC CONDITIONS



ANALYSIS NAME

STATIC CONDITIONS
2.1m HIGH RETAINING WALL

LOCATION

5574 ROCKDALE ROAD, VARS
CUMBERLAND WARD
CITY OF OTTAWA, ONTARIO

PROJECT

SLOPE STABILITY ANALYSIS
PROPOSED RETAINING WALL

CLIENT

BERGERON CONSTRUCTION 2010

DATE	DRAWING No.	DRAWN BY	SCALE	FILE NO.
May 2021	1 of 2	DGM	As Shown	021311

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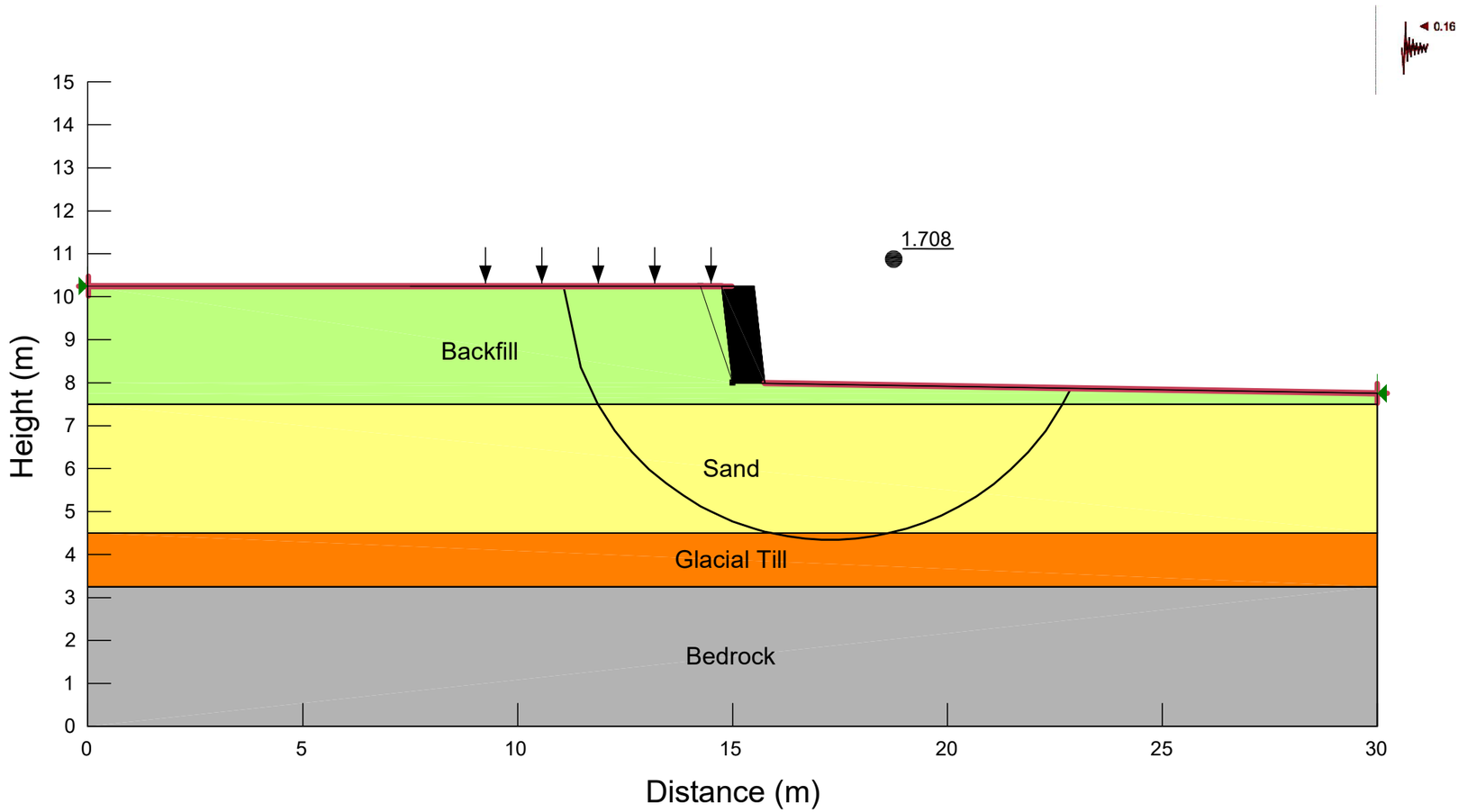

ANALYSIS NAME

PSEUDO-STATIC
2.0m HIGH RETAINING WALL

LOCATION

5574 ROCKDALE ROAD, VARS
CUMBERLAND WARD
CITY OF OTTAWA, ONTARIO

PROJECT

SLOPE STABILITY ANALYSIS
PROPOSED RETAINING WALLS

CLIENT

BERGERON CONSTRUCTION 2010

DATE	DRAWING No.	DRAWN BY	SCALE	FILE NO.
May 2021	2 of 2	DGM	As shown	021311

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